XXIV. *A further Description of the Anatomy of the Mammary Organs of the Kangaroo. By John Morgan, Esq., F.L.S.*

Read April 6, 1830.

Having upon a former occasion presented the Society with a description of certain changes which take place in the structure and functions of the mammary organs of the Kangaroo, during the period of approaching puberty, as well as during several different periods of gestation; I now beg leave to offer a few additional facts relative to the anatomy of these parts, which I have recently been made acquainted with, by a dissection of a much younger animal than any that I had previously examined.

It will be recollected, that in my former communication I described the anatomical peculiarities which I had met with in the mammæ of the adult, and in those of the half-grown animal. I then stated that in the pouch of the adult and impregnated kangaroo, we always find four distinct and perfectly formed teats, two being placed on either side, one above the other; and that each of the four teats is attached to its respective mammary gland: whilst in the younger and unimpregnated animal (when nearly approaching the age of puberty) only two of the four adult teats can be discovered; these being the upper on each side. I pointed out the mode in which the two lower ones became developed: viz. by the protrusion and eversion of membranous cylindrical canals imbedded in the interior of the

lower mammary glands. Each of these canals was described as terminating at one extremity by an open mouth upon the surface of the skin, the opposite end of the tube being closed by a papillary projection (the future nipple). The lining membrane of that tube was represented as forming a sort of pouch from its reflection over this papillary termination. Thus in the development of the inferior teats on each side, the membranous tube or canal becoming everted from the protrusion of the imbedded nipple through its external opening, its lining membrane must necessarily be turned inside-out to form a cutaneous covering for the protruded teat. This process of eversion, which is somewhat similar to the replacement of an inverted finger of a glove, is peculiar to marsupial animals.

In the paper to which I refer, I have also stated that the inferior mammary glands on each side are very much larger than the upper ones; that the young of the animal when first received into the pouch is invariably found attached to one of the two lower teats; and that the milk during the whole period of suckling is furnished by the inferior mammæ. The upper teats, which I had found perfectly developed in the half-grown subject, were compared to those supernumerary organs of the same kind which are so frequently met with in other mammiferous quadrupeds. I have thought it necessary to refer thus far to my first paper on this subject, in order to render the details of my present communication more clearly understood. In the month of October, 1828, I obtained a living female kangaroo, the pouch of which contained a young one still adhering to the marsupial teat, the size of the young at the time being about equal to that of a small rat; its skin was entirely destitute of hair, of a light flesh colour, and constantly lubricated by a viscid moist secretion of a brownish red colour, which secretion was spread also over the whole of the interior of the pouch.

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Since I became possessed of this animal it has been my endeavour to overcome by domestication its natural timidity and shyness, with a view of being thus enabled to ascertain, by a very frequent examination of the interior of the pouch, some additional facts relative to the changes which are known to take place in the economy of its contents during different periods of gestation; since we can expect by such a mode of investigation alone to obtain any satisfactory information respecting the obscure process of parturition in marsupial animals. My attempts to domesticate the kangaroo have been completely successful, the principal obstacle with which I had to contend being the extreme timidity of the animal. I found, however, after it had been in my possession a few weeks, perfectly excluded from any object of alarm, and accustomed to feed from my own hand, that I was permitted, without any effort on the part of the animal to prevent me, to introduce my hand into the pouch, and to make, for as long a period as I could wish, and as frequently as I thought proper, the most complete examination of the young one within, and of the teat to which it was adherent.

After about six weeks the animal became completely familiarised, and would follow either myself or my servant about the lower part of my house like a dog.

As the young one had been already delivered into the pouch, my observations were of course confined to the condition of the pouch and teats during its growth: these may perhaps appear of a nature too trivial for the subject of a communication to the Society; yet, as we are at present so completely in the dark respecting the ultimate object of our researches,—namely a knowledge of the mode in which the fœtus is passed from the uterus to the teat,—and as it is therefore impossible to determine how far a few insulated facts my assist in bringing our

inquiries to a satisfactory termination, I am induced to state briefly the result of my observations, before I describe the anatomical peculiarities in the mammary organs, to which I have already referred, and which were made known to me by a dissection of the young animal in question.

In speaking of the reddish brown secretion of the pouch upon a former occasion, I stated that it was very much diminished, or altogether suspended, at the time the young animal is lodged within the part. I have now ascertained from repeated examinations, that in the unimpregnated state this secretion is always darker in colour, and more viscid in consistence than during gestation; that after the young has been brought into the pouch it becomes of a lighter red and more fluid, and that when the young has dropped from the teat and is perfectly covered with hair the secretion cannot be detected by its colour, although, from a slight moisture of the interior of the bag, it is probable that it still exists in an altered condition. Its use in lubricating the imperfectly formed animal and the cavity in which it is contained, as a means of preventing friction between the two, must be obvious to every one. After I was enabled to examine the pouch as freely as I wished, my first endeavour was to ascertain whether a marsupial animal so imperfectly formed, and in such an immature state, could be considered as existing in a condition analogous to that of the suckling young of other mammiferous quadrupeds. There can be no doubt that such is not the case when it is first attached to the teat; for then I have already shown, that in its state of imperfect organization its nourishment is injected by the mother through the teat into its adhering mouth, instead of being extracted by the young itself, as in the case of other mammiferous quadrupeds. I may also state, that when, in the very early periods of extra-uterine existence, the marsupial fœtus has been separated from the teat,

teat, its life has been destroyed in every instance which I have hitherto met with. It seems therefore fair to infer in such cases, that the organization and general condition of the marsupial young is intermediate between the state in which we find other classes of mammalia whilst inclosed in the uterus and after they have been brought forth; for it must be manifest, that in such cases the re-union of the lips of the immature animal to the separated teat is prevented by an absence of those powers of volition with which other newly born quadrupeds are invariably endowed. Numerous other arguments, which I need not now instance, might be brought forward in proof of the fact, that the first period of extra-uterine existence in marsupial animals is intermediate between the two states which I have just mentioned.

Now, as somewhat more than a mere matter of curiosity, it may be interesting to future inquirers to know at what period the re-union of a separated marsupial young one from the teat can be effected; since at that period it may be presumed that the immature animal is no longer receiving involuntarily the nourishment of the mother; and since we have reason to believe that it is at this time that the intermediate state of existence to which I have alluded will have ceased.

This can only be known by repeated experimental examinations, made by others whose opportunity must be much more extensive than my own; and for their information therefore I have to state, that I have repeatedly separated from its adherent teat the young of the kangaroo whilst perfectly naked and apparently blind, and at a time when its size was not equal to that of a large Norway rat; and that I have in more than one instance prevented a re-union for nearly two hours, with a view of ascertaining how far a *constant* supply of milk under such circum-

circumstances was necessary to the existence of this animal. The result of such experiments has proved to me, that in this advanced state it is decidedly a voluntary agent, and must be considered as having outlived any intermediate state of existence between fœtal and perfect life; for in all my experiments I found that the young one, at the age I have mentioned, was respiring, and capable of applying its mouth to the teat of the mother. At what earlier period the same artificial separation may be effected without destruction of its life, I must leave as a question for others to decide. In the beginning of February the young one was completely covered with hair; and at this time the red secretion from the interior of the pouch, which had for many weeks been gradually diminishing, was no longer perceptible. In the following June it left the pouch for the first time, and being somewhat awkward in finding its way back again, an assistance was afforded by the mother in the following way. The parent bent down until her belly nearly touched the ground; she then introduced her fore paws into the opening of the pouch, and thus pulling the aperture wide open at the same time that it was lowered nearly to a level with the ground, a very easy access was afforded for its tenant. This was frequently repeated for the first month after the young had left the bag.

Having dissected a suckling kangaroo in which two elongated and perfect marsupial teats were apparently found to have conveyed nourishment to a single young one, I was surprised to find that, in the animal to which I am now referring, only one and the same teat was affording a supply of milk throughout the whole period of suckling, this being the one to which the fœtus was adherent when first received into the pouch.

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The different degrees of development met with in the mammary organs of the two animals have been since partly explained to me in the following way.

Where a number of female kangaroos have been confined in the same inclosure, and have borne in their pouches their respective young of nearly the same age and size,—under such circumstances it has now and then happened that two of the little ones, having escaped from their pouches, have formed an association and returned to the common pouch of one or other of the mothers; the animal therefore which is thus destined to carry double, must of course be called upon to furnish a double supply of nutriment for the tenants of her pouch: it appears to me, then, that whenever such is the case, the additional supply is afforded by a sympathetic and increased action of the vessels of the opposite mamma, in consequence of which a corresponding secretion of milk is produced, and of course an equal enlargement of the mammæ and teats on both sides. That such might have been the cause which gave rise to the development of two mammæ and teats in the kangaroo which I had formerly examined, is rendered probable from the circumstance of her having been confined in company with others which were also bearing young. I am unable however to prove the truth of the position which I have advanced by other than circumstantial evidence and analogical deductions; since I have never had an opportunity of examining the pouch of any of these animals under the circumstances mentioned. I may however remark, that I have never met with a single instance in which two teats had been developed in the same animal for the supply of a single young one.

With this brief notice of the changes which I have lately observed in the condition of the pouch and its contents, I have now to describe the appearances presented on dissection of the mammary

mammary organs of the young animal, which died about two months after it had entirely quitted the pouch, and at an earlier age than any I had previously examined. On opening the pouch after death, I found that not one of the four future teats was to be discovered (Fig. 1.), but that four distinct follicular apertures occupied the situation in which the nipples are afterwards found to protrude: from this circumstance I had no doubt that not only the lower, but the upper teats also, of the kangaroo were originally formed from the eversion of follicular canals, of which the external apertures were thus exposed, and that consequently the analogy which I had drawn between the superior teats of this animal and the supernumerary nipples of other quadrupeds, was applicable to their functions only, and not to any similarity in their structure and development.

The fact that all the four teats in the kangaroo are formed in precisely the same way, was clearly proved by a dissection of the mammary glands in the young animal before me; for on tracing the course of the upper follicular openings, I found in them an exact correspondence with that peculiarity of structure which I have already described as existing in the lower mammæ previous to the appearance of their nipples (Fig. 2.). At this early period of life, however, it will be seen that the four glands are of nearly the same size, and that they have not yet acquired sufficient magnitude to envelop completely their membranous canals.

It appears then from this dissection and from my former one, that the young of the kangaroo at a very early period of life is devoid of any external mammary organs; that their first appearance is shown in the development of the two superior and apparently supernumerary and useless teats; that subsequently the inferior teats are protruded from their respective glands, and that